

REMARKS/ARGUMENTS

In the Office Action dated July 8, 2003, (1) the Declaration, the specification and certain claims are objected to, (2) the claims are provisionally rejected for obviousness-type double patenting, and (3) certain claims are rejected under 35 U.S.C. § 103(a). Applicants respectfully request consideration of the foregoing amendments and the following remarks and arguments, and withdrawal of the remaining rejections.

Status of the Claims

Claims 1-9 and 39-52 and 53 are canceled.

Claims 13, 25, 28, 35 and 54 are currently amended.

New claims 55-58 have been added.

Claims 10-38 and 54-58 are pending.

Oath/Declaration

In the Office Action, the Declaration submitted on March 21, 2002 is said to be defective for lacking reference to the priority applications 60/146,635 and 60/256,285. A new *Declaration (37 CFR 1.63) for Utility or Design Application Using An Application Data Sheet (37 CFR 1.76)* (with attached Application Data Sheet including domestic priority information) is enclosed herewith.

Objection to the Specification

Paragraphs 0001, 0045, 0047 and 0057 have been amended to update the status and application information of the referenced patent applications. A patent has not yet been granted in U.S. Patent Application No. 09/625,710 filed July 25, 2000.

Claim Objections

Claims 28, 53 and 54 are objected to in the Office Action. Claim 28 has been amended to recite the species of "divided units" using Markush language. Claim 53 has been canceled as containing subject matter that would be somewhat duplicative of subject matter in claim 35, if claim 53 were to be amended to depend from a non-canceled claim. Claim 54 has been amended to require that the waste gas desulfurization process include an initial carbiding step before exposure to the H₂S-containing gas. This amendment is supported in the specification at paragraphs 46-47, for example.

Double Patenting

Claims 10-38, 53 and 54 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-30 and 36-40 of copending

Application No. 10/024,679. Without acquiescing to the reasons stated in the Office Action of July 8, 2003, or admitting that any or all of the present claims conflict with any claim in co-pending Application No. 10/024,679, in the interest of advancing prosecution in the instant matter, Applicants are willing to submit a terminal disclaimer under 37 CFR 1.321(c) to obviate this rejection. If the rejection is maintained after consideration of the current amendments, Applicants respectfully request that the requirement for submission of a terminal disclaimer be held in abeyance until claims in the present application are otherwise deemed allowable but for the double patenting rejection.

Rejections Under 35 U.S.C. § 103(a)

In the Office Action of July 8, 2003, claims 10-12, 14-22, 24, 27-30, 35-38, 53 and 54 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *WO 97/19019* (in the French language) in view of pages 457-460 in the Gas Purification reference by Kohl et al.

It is stated in the Office Action that *WO 97/19019* discloses a process for the oxidation of hydrogen sulfide into elemental sulfur by passing the hydrogen sulfide-contaminated gas (together with an oxygen-containing gas (pg. 4, ll. 1-12 of *WO 97/19019*)) through a catalyst [containing] a variety of catalytic metals wherein the catalytic metals are supported on a silicon carbide support so that the catalyst promotes the oxidation of the hydrogen sulfide into elemental sulfur (referring to the English abstract of *WO 97/19019*) at temperatures ranging from 30 to 1,000°C (pg. 6, ll. 28-33 of *WO 97/19019*) and for a time period ranging from 1/2 second to 20 seconds (pg. 6, ll. 10-14 of *WO 97/19019*), and then passing the gas through a condenser to condense the elemental sulfur out of the gas. The advantages of using a silicon carbide support are said to be the resistance to sulfation and the avoidance of combustion (pg. 3, ll. 23-26 of *WO 97/19019*). A variety of transition metals are said to be useful (pg. 2, ll. 8-30 of *WO 97/19019*). The difference between Applicants' claims and *WO 97/19019* is said to be that the claimed reaction temperature limitations overlap (citing pg. 6, ll. 28-29 of *WO 97/19019*.)

Since *U.S. Patent No. 6,083,471* (in the English language) states that it is the U.S. national stage counterpart of *WO 97/19019*, Applicants' respectfully request leave of the Examiner to refer to passages in the English language counterpart ("the '471 patent") in addition to or instead of the corresponding cited passages of *WO 97/19019*, which are in the French language. The referenced passages of *WO 97/19019* are believed to correspond, respectively, to the following passages of *U.S. 6,083,471*:

at col. 2, ll. 39-50 (corresponding to pg. 4, ll. 1-12 of *WO 97/19019*),

The subject of the invention is therefore a process for oxidizing H_2S present at a low concentration in a gas directly to sulphur by a catalytic route, the said process being of the type in which the said gas containing H_2S is passed with a gas containing free oxygen, in a quantity such as to provide an $\text{O}_2:\text{H}_2\text{S}$ molar ratio ranging from 0.05 to 10, in contact with a catalyst for selectively oxidizing H_2S to sulphur consisting of a catalytically active phase containing at least one metal existing in the form of a metal compound and/or in the elemental state, and it is characterized in that the said support consists of silicon carbide.

at col. 4, ll. 5-12 (corresponding to pg. 6, ll. 28-33 of *WO 97/19019*),

The temperatures for implementing the process according to the invention may advantageously be chosen between 30°C . and 1000°C . For implementation of the process at temperatures above the dew point of the sulphur formed, temperatures of between 180°C . and 1000°C . and more especially between 200°C . and 900°C . are chosen.

at col. 3, ll. 55-57 (corresponding to pg. 6, ll. 10-14 of *WO 97/19019*),

The contact times of the gaseous reaction mixture with the oxidation catalyst may range from 0.5 of a second to 20 seconds and preferably from 1 second to 12 seconds ...

at col. 2, ll. 26-28 (corresponding to pg. 3, ll. 23-26 of *WO 97/19019*),

The silicon carbide support, in contrast to an alumina support, is not subject to sulphation and, unlike an active charcoal support, is not combustible.

at col. 1, ll. 41-64 (corresponding to pg. 2, ll. 8-30 of *WO 97/19019*),

...one or more compounds of transition metals chosen from Fe, Cu, Zn, Cd, Cr, Mo, W, Co and Ni, preferably Fe, and optionally with one or more compounds of precious metals chosen from Pd, Pt, Ir and Rh, preferably Pd (FR-A-2511663), or else of a thermally stabilized alumina used in combination with one or more compounds of transition metals such as the abovementioned, especially Fe, and optionally with one or more compounds of precious metals chosen from Pd, Pt, Ir and Rh (FR-A-2540092).

Oxidation of H_2S to sulphur, the operation being carried out at temperatures such that the sulphur formed is deposited on the catalyst, can, for its part, be performed in contact with a catalyst consisting, for example, of one or more compounds such as salts, oxides or sulphides of transition metals, for example Fe, Cu, Cr, Mo, W, V, Co, Ni, Ag and Mn, in combination with a support of the activated alumina, bauxite, silica/alumina or zeolite type (FR-A-2277877). This oxidation of H_2S with deposition of sulphur on the catalyst can also be carried out in contact with a catalyst consisting of a catalytic phase chosen from the oxides, salts or sulphides of the metals V, Mo, W, Ni and Co used in combination with an active charcoal support (French Patent Application No. 9302996 of 16.03.1993).

col. 4, ll. 5-7,

The temperatures for implementing the process according to the invention may advantageously be chosen between 30°C. and 1000°C.

and col. 4, ll. 5-7 (corresponding to pg. 6, ll. 28-29 of *WO 97/19019*),

The temperatures for implementing the process according to the invention may advantageously be chosen between 30°C. and 1000°C.

With respect to claim 10¹, it is said in the Office Action of July 8, 2003 that it differs from *WO 97/19019* in that it describes the reactor as containing a gas mixing zone, a reaction zone and a cooling zone. The same reactor layout is said to be shown in Fig. 8-16 of the Gas Purification reference by Kohl et al. The Office Action suggests that it would be obvious to modify the process of *WO 97/19019* by substituting the Thermal Stage lay-out illustrated in Fig. 8-16 of Kohl et al. in lieu of the reactor layout used for the process described in *WO 97/19019*.

In reply, Applicants respectfully submit that the thermal stage reactor illustrated in Fig. 8-16 of Kohl et al. is a partial combustion burner/reaction furnace, not a millisecond contact time reactor containing a catalyst device (claim 10). See, for example, page 457 of the Kohl et al. reference, where Fig. 8-16 is described as follows:

In the partial combustion process, which is shown diagrammatically in Figure 8-16, the entire acid-gas stream, and the stoichiometric amount of air to burn one-third of the hydrogen sulfide to sulfur dioxide is fed through a burner to the reaction furnace.

Moreover, the Claus-type thermal stage reactions set out in Fig. 8-16, *i.e.*, $\text{H}_2\text{S} + 3/2 \text{O}_2 \rightarrow \text{SO}_2 + \text{H}_2\text{O}$ and $\text{SO}_2 + 2\text{H}_2\text{S} \leftrightarrow 3\text{S} + 2\text{H}_2\text{O}$, are clearly different than the direct partial oxidation reaction recited in Applicants' claim 10. Thus, there would be no motivation to combine the references as suggested in the Office Action. If, *arguendo*, the process of *WO 97/19019* were modified by substituting the thermal stage of Kohl et al. for the oxidation reactor of *WO 97/19019*, the reactions taking place would be different and one would not have the process of any of claims 10-12, 14-22, 24, 27-30, 35-38 and 54. It appears that neither *WO 97/19019* nor the Kohl et al. reference describes a process operated at a space velocity of 20,000 hr⁻¹ or more (claim 37) or at superatmospheric pressure (claim 38). Neither does either reference describe a process that includes carbiding the catalyst prior to treating the H₂S-containing gas (claim 54).

¹ It is assumed that, in the Office Action of July 8, 2003, the references to "claim 1" are a typographical error and that "claim 10" is intended.

Claims 10-12, 14-38, 53 and 54 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *WO 97/19019* in view of pages 457-460 in the Gas Purification reference by Kohl et al. as applied above, and further in view of U.S. Pat. 6,099,819 ("the '819 patent"). In the Office Action it is said that the difference between Applicants' claims and *WO 97/19019* and that of Applicants' claims 25, 26 and 31-34 is that Applicants' claims call for the presence of a lanthanide-based metal (such as lanthanum or samarium) as the catalyst that promotes the oxidation of the hydrogen sulfide into elemental sulfur. The Office Action takes the position that it would have been obvious to one of ordinary skill in the art at the time Applicants' invention was made to modify the process of *WO 97/19019* in view of Kohl et al. by including and/or using lanthanide metals such as Sm and La (citing col. 3, l. 55 to col. 4, l. 2 of the '819 patent).

In reply, Applicants respectfully traverse this rejection. As discussed above, there would have been no motivation to combine the *WO 97/19019* and Kohl et al. references at the time Applicants' invention was made. The '819 patent, at col. 3, l. 58 - col. 4, l. 2, teaches that "the catalyst comprises a mixture of metal oxides containing titanium oxide and one or more metal oxides." The metal oxide used together with titanium oxide can include La or Sm. The '819 patent also teaches that the "[c]atalysts of this invention can operate at temperatures between about 100°C and about 400°C... ." Clearly one of ordinary skill in the art at the time Applicants' invention was made would not have been motivated to combine a catalyst of the '819 patent with the process of *WO 97/19019*, especially if combined with the teaching of Kohl et al. as suggested above. There could be no reasonable expectation of success in a process operating above 400°C. Thus, claims 11, 17-19, each of which recites a reaction zone temperature above 400°C, would not be reasonably expected from such combination. It is noteworthy that Example 4 appears to be the only instance in the '471 patent (and presumably, *WO 97/19019*) where the process includes a temperature significantly above the dew point of sulfur. In this instance, it appears that the catalytic oxidation stage is carried out in Claus stoichiometry followed by a Claus reaction stage carried out in two successive stages. See col. 10, lines 52-54 of the '471 patent. In that example, the selectivity of the process for sulfur was 59%, with the molar ratio of $\text{H}_2\text{S} : \text{SO}_2$ in the effluent equal to 2:1. The high temperature portion of that process does not appear to comprise a primarily direct partial oxidation reaction.

The platinum-rhodium alloy of claims 33 and 34 are not taught or suggested in the catalysts of the '819 patent nor in the '471 patent. Neither is the carbided catalytic metal of currently amended claim 35, 36 and 54 taught or suggested by the '819 patent or the '471 patent. Notably, the '471 patent

(and presumably, *WO 97/19019*) teaches using a carbided support, but it does not appear to teach a process that includes first carbiding the catalytic metal. For at least the foregoing reasons, claims 10-38, 54 and new claim 55 are believed to be patentable over the cited references.

Applicants gratefully acknowledge that claim 13 is not rejected under either 35 U.S.C. § 102 or 35 U.S.C. § 103. In the Office Action it is said that *WO 97/19019* sets forth a minimum reaction time of 500 milliseconds, whereas claim 13 sets forth that the contact time is no more than 200 milliseconds.

Additional Amendments

Figures 3A and 3B have been voluntarily amended to correct the inadvertent omission of reference number 54. The amendments are supported in paragraph 0037 of the original specification, which recites a "desulfurized waste gas outlet" that is also referred to as "outlet 54." Paragraph 0037 is also currently amended to insert reference number "54" after "desulfurized waste gas outlet." This amendment does not constitute new matter.

Claim 13 has been rewritten in independent form, incorporating all of the limitations of independent claim 10, from which it originally depended. The scope of this claim is unchanged.

Claims 25 has been voluntarily amended for better consistency with the terminology of the Specification (*e.g.*, paragraphs 0040 and 0045). The scope of claim 25 is unaffected by this amendment.

New claims 55-58 have been added to recite specific embodiments to which Applicants' are justly entitled. Claims 55-57 are supported in the specification at page 9, paragraph 20, and recite, respectively, "less than 50 milliseconds," "less than 20 milliseconds," and "less than 10 milliseconds." These claims are believed to be free of the prior art for at least the same reasons as claim 13. New claim 58 recites certain conversion and selectivity criteria for the process, is supported in Table 1 of the Specification (pg. 19), is also believed to be free of the prior art.

Conclusion

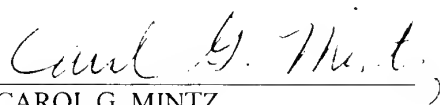
Applicants may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims.

Moreover, it should be understood that there may be other arguments with respect to patentability which have yet to be raised, but which may be raised in the future. The format of this Amendment and Response to Office Action is believed to conform with the Revised Amendment Practice as described in "Changes To Implement Electronic Maintenance of Official Patent Application Records," 68 Fed. Reg. 38611 (June 30, 2003).

All of the pending claims are believed to be free of the prior art, and reconsideration and withdrawal of the rejections and objections are respectfully requested. Applicants believe that this is a full and complete response to each rejection, objection and requirement. If any item has been overlooked, Applicants respectfully request the opportunity to supplement this response.

If any issues remain unresolved, Applicants respectfully request a telephonic Examiner Interview to facilitate the resolution of such matters. Should any fees have been inadvertently omitted, or if any additional fees are required or have been overpaid, please appropriately charge or credit those fees to Deposit Account Number 03-2769 of Conley Rose, P.C., Houston, Texas, and consider this a petition for any necessary extension of time.

Respectfully submitted,


CAROL G. MINTZ
Reg. No. 38,561
Conley Rose, P.C.
P.O. Box 3267
Houston, Texas 77253-3267
(713) 238-8000

AGENT FOR APPLICANTS

APPENDIX

1. **Annotated drawing sheet showing changes to Fig. 3A**
2. **Annotated drawing sheet showing changes to Fig. 3B**
3. **Replacement drawing sheet containing amended Fig. 3A**
4. **Replacement drawing sheet containing amended Fig. 3B**

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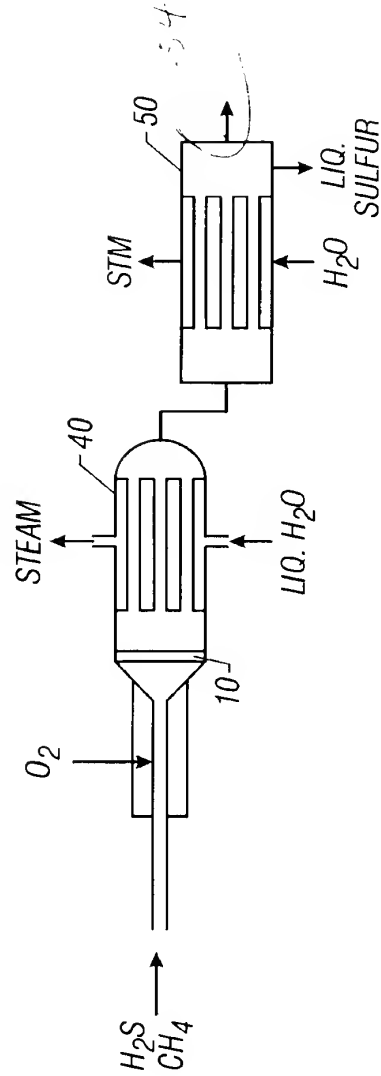


FIG. 3A

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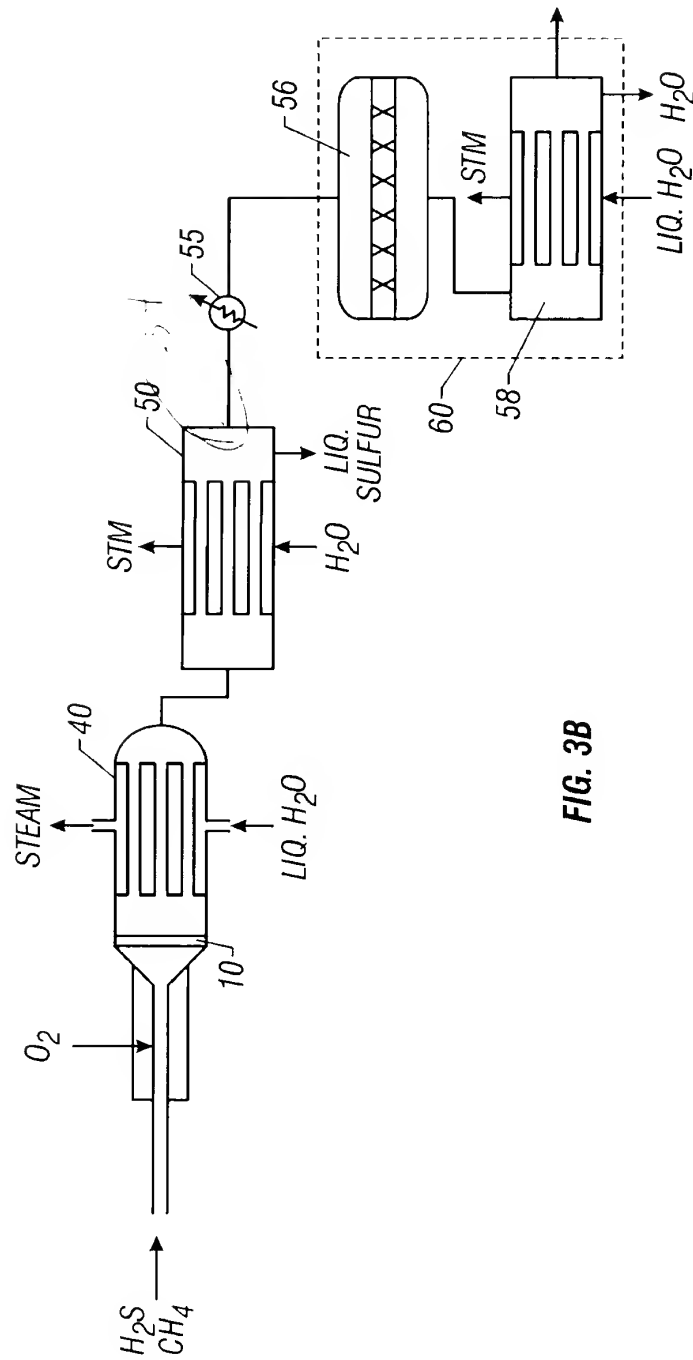


FIG. 3B